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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/677,826	10/02/2003	Yusong Yin	267-34	9808

7590 11/21/2005

JAMES A. QUINTON
Suite 1210
551 Fifth Avenue
New York, NY 10176

EXAMINER	
UNELUS, ERNEST	

ART UNIT	PAPER NUMBER
2828	

DATE MAILED: 11/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

EL

Office Action Summary	Application No.	Applicant(s)
	10/677,826	YIN ET AL.
	Examiner	Art Unit
	Ernest Unelus	2828

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *02 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-56* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-56* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *10/02/03*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-27, 38, 39, and 54-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yin (US pat. 6,108,356) in view of Butterworth et al. (US pub. 2004/0179559.

With respect to claims 1, 22-27, 38, and 56, Yin discloses:

1a, 38a, and 56a) a laser providing a preselected wavelength beam comprising: a) a laser resonator having a laser resonator cavity formed between a first laser resonator reflective surface (M1) and a second laser resonator reflective surface (M2), said laser resonator having a resonator optical axis (see fig. 1);

1b, and 56b) a lasing medium located within said laser resonator cavity for generating a fundamental wavelength beam (see Yin, claim 1b);

1c, 38c, and 56c) an optical parametric oscillator (OPO) cavity formed between a first OPO reflective surface (M1) and a second OPO reflective surface (M4) said optical parametric oscillator cavity having an oscillator optical axis which is in part separate

from said resonator optical axis and which in part overlaps said resonator optical axis (see Yin, fig. 1, claim 1c);

1d and 56d) a nonlinear generator for OPO generation located within said OPO cavity along said oscillator optical axis and along said resonator optical axis in optical communication with said first and said second OPO reflective surface; said nonlinear generator oriented to convert said fundamental wavelength preselected beam into a preselected wavelength beam having a preselected longer wavelength than said fundamental beam (see Yin, claim 1d);

1e and 56e) means to direct said fundamental wavelength beam into said optical parametric oscillator cavity along said oscillator optical axis and through said nonlinear generator to convert a first portion of said fundamental wavelength beam into a preselected wavelength beam having a having a longer wavelength than said fundamental beam (see Yin, claim 1e);

1g and 56g) said fundamental beam reflected by said first resonator reflective surface back through said nonlinear generator to convert a second a portion of said fundamental laser beam to preselected wavelength beam; said preselected wavelength beam reflected by said OPO first reflective surface to oscillate said preselected wavelength beam in said OPO cavity (see col. 4, lines 33-50) (see also, Yin, claim 1g);

1i and 56i) a first beam separator in optical communication with said nonlinear generator to separate said preselected wavelength beam from said fundamental wavelength beam after said second portion of said fundamental wavelength beam has been converted to preselected wavelength beam (see Yin, claim 1h);

1j and 56j) fundamental beam directing means to direct said separated fundamental beam back through said lasing medium for further amplification (see col. 4, lines 53-55);

1k and 56k) preselected wavelength beam directing means for directing said separated preselected wavelength beam to said second OPO reflective surface
where said beam is at least partially reflected back through said nonlinear
generator (see Yin, claim 1J).

38b) a Nd:YAG, Nd:YLF, Nd:GdVO4 or Nd:YVO4 lasing crystal located within said laser resonator cavity for generating a fundamental wavelength beams (see Yin, claims 17 and 19)

38d) a noncritically phased matched nonlinear crystal for OPO generation
located within said OPO cavity along said oscillator optical axis and along said resonator optical axis in optical communication with said first and said second OPO reflective surfaces (see Yin, col. 4, lines 18-19);

38e) said noncritically phased matched nonlinear crystal oriented to convert said fundamental wavelength beam into a preselected output wavelength beam having a preselected longer wavelength than said fundamental beam (see Yin claim 15d);

38g) said first resonator reflective surface reflective of fundamental wavelength beam and said first OPO reflective surface at least partially reflective of output wavelength beam so that fundamental and output beams reflected by said reflective surfaces propagate back through said nonlinear crystal (see Yin, claim 15e);

38h) a dichroic mirror (M3) located along the overlapping portion of said oscillator optical axis and said resonator optical axis between said nonlinear crystal and said lasing medium (see Yin, fig. 1); said dichroic mirror either highly reflective or highly transmissive for fundamental wavelength beam to direct said fundamental wavelength beam propagating from said lasing medium into said optical parametric oscillator cavity along said oscillator optical axis and through said nonlinear crystal to convert a portion of said fundamental wavelength beam to a preselected wavelength beam having a longer wavelength than said fundamental beam; said dichroic mirror directing fundamental beam reflected by said first resonator reflective surface back through said lasing medium for amplification and directing preselected output wavelength beam reflected by said first OPO reflective surface for at least partial reflection by said second OPO reflective surface (see Yin, col. 3 lines 39- 64 and col. 4, lines 53-55).

Yin fail to disclose a nonlinear crystal generator faces having a Brewster cut at the

intersection of said nonlinear generator and said axes so that the fundamental beam and the preselected wavelength beam incident on said generator within 10 degrees from the Brewster angle for said generator. However, a nonlinear crystal generator faces having a Brewster angel cut at the intersection of said nonlinear generator and said axes so that the fundamental beam and the preselected wavelength beam incident on said generator is well taught by Butterworth (paragraph. 0041). It is also an inherent feature to have the incident beam on a nonlinear crystal generator to within a particular degree from the Brewster angle for a nonlinear crystal generator. It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine Butterworth's references above with Yin's invention because having the nonlinear crystal at Brewster cut angle will minimize reflection the second (non-mirror) surface without providing an antireflection coating. An optically nonlinear crystal is also located on the axis between two mirrors to double the frequency of a second-harmonic radiation.

With respect to claim 2, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses a Q-switch (see fig. 3).

With respect to claims 3-6, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses an acousto-optic, electro-optic, and a passive Q-switch, which is a Cr+4:YAG crystal (see col. 4, lines 9-11).

With respect to claims 7 and 18, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses wherein said nonlinear generator is a nonlinear OPO crystal cut for noncritical phase matching (see col. 4, lines 18-19).

With respect to claims 8 and 39, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses an output coupler to remove a portion of said preselected wavelength beam outside said optical parametric oscillator cavity (see col. 4, lines 43-61).

With respect to claims 9 and 10, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses said first OPO reflective surface and said first laser resonator reflective surface formed by a single mirror (M1), said mirror highly reflective for fundamental beam and at least partially reflective for preselected wavelength beam (see col. 3, lines 33-38).

With respect to claim 11, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses the nonlinear crystal is a KTP, KTA, RTA, or RTP crystal (see Yin, claim 19).

With respect to claims 12, 16, 17, 19, 20, 21, 54, and 55, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses wherein said lasing medium is an Nd:YAG, Nd:YLF, Nd:GdVO4, and nonlinear generator is KTP or KTA crystal (see Yin, claims 17 and 19).

With respect to claims 13 -15, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses said wavelength of preselected wavelength beam is an eyesafe wavelength (see Yin, col. 1, lines 16-18).

With respect to claims 52 and 53, Yin and Butterworth disclose everything as claimed above. In addition, Yin discloses an output coupler to provide said first or said second optical parametric oscillator reflective (M1) surface and being transmissive (see col. 4, lines 43-61).

Claims 28- 32, and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yin (US pat. 6,108,356) in view of Butterworth et al. (US pub. 2004/0179559) and further in view of Yin et al. (US pub. 2002/0080841), which I will refer to as Yin et al. from thereon.

With respect to claims 28-32, Yin and Butterworth disclose everything as claimed above, including an output coupler. Yin and Butterworth fail to disclose multiple harmonic generators that are nonlinear crystal in optical communication with said output coupler. However, multiple harmonic generators that are nonlinear crystal in optical communication with said output coupler is well taught by Yin et al. (paragraph 0007). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include the harmonic generators that are nonlinear crystal in optical communication with said output coupler to achieve frequency modification oriented for

phasing matching.

With respect to claim 43, Yin discloses:

43a) a laser providing a preselected wavelength beam comprising: a) a laser resonator having a laser resonator cavity formed between a first laser resonator reflective surface (M1) and a second laser resonator reflective surface (M2), said laser resonator having a resonator optical axis (see fig. 1);

43b) a lasing medium located within said laser resonator cavity for generating a fundamental wavelength beam (see Yin, claim 1b);

43c) a Nd:YAG, Nd:YLF, Nd:GdVO4 or Nd:YVO4 lasing crystal located within said laser resonator cavity for generating a fundamental wavelength beams (see Yin, claims 17 and 19)

43d) an optical parametric oscillator (OPO) cavity formed between a first OPO reflective surface (M1) and a second OPO reflective surface (M4) said optical parametric oscillator cavity having an oscillator optical axis which is in part separate from said resonator optical axis and which in part overlaps said resonator optical axis (see Yin, fig. 1, claim 1c);

43e) a nonlinear generator for OPO generation located within said OPO cavity along said oscillator optical axis and along said resonator optical axis in optical communication with said first and said second OPO reflective surface; said nonlinear generator oriented to convert said fundamental wavelength preselected beam into a preselected wavelength beam having a preselected longer wavelength than said fundamental beam (see Yin, claim 1d);

43f) means to direct said fundamental wavelength beam into said optical parametric oscillator cavity along said oscillator optical axis and through said nonlinear generator to convert a first portion of said fundamental wavelength beam into a preselected wavelength beam having a having a longer wavelength than said fundamental beam (see Yin, claim 1e);

43h) said first resonator reflective surface reflective of fundamental wavelength beam and said first OPO reflective surface at least partially reflective of output wavelength beam so that fundamental and output beams reflected by said reflective surfaces propagate back through said nonlinear crystal (see Yin, claim 15e);

43i) said fundamental beam reflected by said first resonator reflective surface back through said nonlinear generator to convert a second a portion of said fundamental laser beam to preselected wavelength beam; said preselected wavelength beam

reflected by said OPO first reflective surface to oscillate said preselected wavelength beam in said OPO cavity (see col. 4, lines 33-50 and claim 1g);

43j) a first beam separator in optical communication with said nonlinear generator to separate said preselected wavelength beam from said fundamental wavelength beam after said second portion of said fundamental wavelength beam has been converted to preselected wavelength beam (see Yin, claim 1h);

43k) fundamental beam directing means to direct said separated fundamental beam back through said lasing medium for further amplification (see col. 4, lines 53-55);

43l) preselected wavelength beam directing means for directing said separated preselected wavelength beam to said second OPO reflective surface
where said beam is at least partially reflected back through said nonlinear generator (see Yin, claim 1J).

43m) an output coupler to direct a portion of said output wavelength beam on an output path outside said optical parametric oscillator cavity (see Yin, col. 4, lines 58-61)

Yin fail to disclose a nonlinear crystal generator faces having a Brewster cut at the intersection of said nonlinear generator and said axes so that the fundamental beam and the preselected wavelength beam incident on said generator within 10 degrees from the Brewster angle for said generator. However, a nonlinear crystal generator

faces having a Brewster angel cut at the intersection of said nonlinear generator and said axes so that the fundamental beam and the preselected wavelength beam incident on said generator is well taught by Butterworth (paragraph. 0041). It is also an inherent feature to have the incident beam on a nonlinear crystal generator to within a particular degree from the Brewster angle for a nonlinear crystal generator. It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine Butterworth's references above with Yin's invention because having the nonlinear crystal at Brewster cut angle will minimize reflection the second (non-mirror) surface without providing an antireflection coating. An optically nonlinear crystal is also located on the axis between two mirrors to double the frequency of a second-harmonic radiation.

Yin and Butterworth disclose everything above, including, an output coupler, without specifically disclosing multiple harmonic generators that are located along said output path for converting a portion of multiple harmonic beam from said preselected wavelength beam. However, multiple harmonic generators that are located along said output path for converting a portion of multiple harmonic beam from said preselected wavelength beam are well taught by Yin et al. (paragraph 0007). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include the harmonic generators that are nonlinear crystal in optical communication with said output coupler to achieve frequency modification oriented for phasing matching.

Claims 44 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable

over Yin (US pat. 6,108,356) in view of Butterworth et al. (US pub. 2004/0179559) and further in view of Yusong et al. (5,936,983).

With respect to claims 44 and 45, Yin and Butterworth disclose everything as claimed above without specifically disclosing a first polarization rotator, which is a waveplate, is located between said second, second harmonic generator and said third harmonic generator for rotating the polarization of either the 772 nm beam or the 38611m beam 1/2 wave so that said 772 nm beam and said 386 nm beam have parallel polarization when passing through said third harmonic generator. A first polarization rotator, which is a waveplate, is located between said second, second harmonic generator and said third harmonic generator for rotating the polarization 1/2 wave so that the beam have parallel polarization when passing through said third harmonic generator is well taught by Yusong (col. 6, lines 36-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to create this configuration to achieve frequency double. It will also be obvious to place a second waveplate between third and fourth harmonic to achieve the same purpose.

Claims 46- 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yin (US pat. 6,108,356) in view of Butterworth et al. (US pub. 2004/0179559), Yusong et al. (US pat. 5,936,983), and further in view of Yin et al. (US pub. 2002/0080841), which I will refer to as Yin et al. from thereon.

With respect to claim 46, Yin, Butterworth, and Yusong disclose everything as claimed above without specifically disclosing that the fourth harmonic generator is located between said first OPO reflective surface and said first beam separator. the fourth harmonic generator between said first OPO reflective surface and said first beam separator is well taught by Yin et al. (see fig. 5). It would have been obvious to one of ordinary skill in the art at the time the invention was made to place the fourth harmonic generator between said first OPO reflective surface and said first beam separator to separate said fourth harmonic beam from said fundamental beam for amplification.

With respect to claims 47-51, Yin, Butterworth, and Yusong disclose everything as claimed above. In addition, Yin et al. discloses the nonlinear generator crystals are a KTP, KTA, RTA, LBO, BBO, or RTP crystal (see paragraph 0007).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Yin (US pat. 6,327,281) discloses a laser resonator cavity overlapping an optical parametric oscillator without specifically disclosing a waveplate between second and third harmonic or a second waveplate between third and fourth harmonic.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ernest Unelus whose telephone number is 571-272-

8596. The examiner can normally be reached on 9:00am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Minsun Harvey can be reached on 571-272-1835. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ZANDRA V. SMITH
PRIMARY EXAMINER

ZANDRA V. SMITH
PRIMARY EXAMINER

E.U